

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of claims:

Claim 1-31

Claim 32 (new): A battery capacity calculating method for calculating a residual capacity and/or residual power of a secondary battery, comprising:

calculating an equilibrium voltage curve C_{equ} showing a relation between a discharged capacity and an equilibrium voltage in said secondary battery;

measuring a terminal voltage V_{mea} and a current value I of said secondary battery at a time of discharging;

calculating a discharged capacity Q_{mea} of said secondary battery based on the terminal voltage V_{mea} and the current value I ;

calculating an apparent equilibrium voltage V_{ocv} by adding a voltage drop ΔV_{dc} by a direct current resistance R_{dc} to the terminal voltage V_{mea} ;

calculating an apparent discharged capacity Q_{ocv} corresponding to the apparent equilibrium voltage V_{ocv} calculated based on the equilibrium voltage curve Q_{equ} ;

calculating a capacity shift ΔQ being a difference between the discharged capacity Q_{mea} and the apparent discharged capacity Q_{ocv} ; and

estimating a discharge curve C_{pre} in a future based on the capacity shift ΔQ calculated at said capacity shift calculating step.

Claim 33 (new): The battery capacity calculating method according to claim 32, wherein when a state of said battery is close to the last stage of discharging, a reduction rate dQ of a capacity shift to a discharged capacity is calculated based on the discharged capacity Q_{mea} and the capacity shift ΔQ , and the discharge curve C_{pre} in the future is estimated based on the capacity shift ΔQ and the reduction rate dQ .

Claim 34 (new): The battery capacity calculating method according to claim 33, wherein the capacity shift ΔQ is expressed by a linear function of the discharged capacity Q_{mea} when the state of said battery is close to the last stage of discharging.

Claim 35 (new): The battery capacity calculating method according to claim 32, wherein when a state of said battery is not in the last stage of discharging, the equilibrium voltage V_{equ} corresponding to the discharged capacity Q_{mea} is calculated based on the equilibrium voltage curve C_{equ} , and the discharge curve C_{pre} in the future is estimated based on the voltage drop ΔV being the difference between the equilibrium voltage V_{equ} and the terminal voltage V_{mea} .

Claim 36 (new): The battery capacity calculating method according to claim 35, wherein the discharge curve C_{pre} is estimated by subtracting the voltage drop ΔV from the equilibrium voltage curve C_{equ} .

Claim 37 (new): The battery capacity calculating method according to claim 35, wherein the discharge curve C_{pre} is estimated using a maximum voltage drop ΔV_{max} corresponding to a maximum load by present in place of the voltage drop ΔV .

Claim 38 (new): The battery capacity calculating method according to claim 32, further comprising calculating the residual capacity and/or the residual power of said secondary battery based on the discharge curve C_{pre} .

Claim 39 (new): The battery capacity calculating method according to claim 32, further comprising performing a judgment whether a state of said battery is near the last stage of discharging or not based on the apparent equilibrium voltage V_{ocv} to switch an estimating method of the discharge curve C_{pre} according to a judgment result.

Claim 40 (new): The battery capacity calculating method according to claim 39, wherein the apparent equilibrium voltage V_{ocv} is compared with a predetermined threshold value to perform the judgment whether the state of said battery is near the last stage of discharging or not.

Claim 41 (new): The battery capacity calculating method according to claim 32, wherein the direct current resistance R_{dc} is calculated based on voltage changes according to current changes.

Claim 42 (new): The battery capacity calculating method according to claim 32, wherein the direct current resistance R_{dc} is calculated based on an average voltage and an average current value.

Claim 43 (new): The battery capacity calculating method according to claim 32, wherein the equilibrium voltage curve C_{equ} is calculated based on equilibrium voltages at least two points and a capacity between the equilibrium voltages.

Claim 44 (new): The battery capacity calculating method according to claim 43, wherein a shrinkage ratio S expressed by a quotient obtained by dividing a fully charged capacity of the secondary battery by a fully charged capacity of an initial battery which is not deteriorated based on the equilibrium voltages at the at least two points and a capacity between the equilibrium voltages.

Claim 45 (new): The battery capacity calculating method according to claim 32, wherein charging is compulsorily stopped and an equilibrium voltage is obtained based on a subsequent voltage change.

Claim 46 (new): The battery capacity calculating method according to claim 32, wherein the calculated residual capacity and/or the calculated residual

power are transmitted to an electronic apparatus using said secondary battery as its power supply.

Claim 47 (new): A battery capacity calculating apparatus for calculating a residual capacity and/or residual power of a secondary battery, comprising:

voltage measuring means for measuring a terminal voltage V_{mea} of said secondary battery at a time of discharging;

current measuring means for measuring a current value I of said secondary battery at the time of discharging; and

operation processing means for calculating the residual capacity and/or the residual power of said secondary battery,

wherein said operation processing means calculates an equilibrium voltage curve C_{equ} showing a relation between a discharged capacity and an equilibrium voltage in said secondary battery, calculates a discharged capacity Q_{mea} of said secondary battery based on the terminal voltage V_{mea} measured with said voltage measuring means and the current value I measured with said current measuring means, calculates an apparent equilibrium voltage V_{ocv} by adding a voltage drop ΔV_{dc} by a direct current resistance R_{dc} to the terminal voltage V_{mea} , calculates an apparent discharged capacity Q_{ocv} corresponding to the apparent equilibrium voltage V_{ocv} based on the equilibrium voltage curve Q_{equ} , calculates a capacity shift ΔQ being a difference between the discharged capacity Q_{mea} and the apparent discharged capacity Q_{ocv} , and estimates a discharge curve C_{pre} in a future based on the capacity shift ΔQ .

Claim 48 (new): The battery capacity calculating apparatus according to claim 47, wherein, when a state of said battery is close to the last stage of discharging, said operation processing means calculates a reduction rate dQ of a capacity shift to a discharged capacity based on the discharged capacity Q_{mea} and the capacity shift ΔQ , and estimates the discharge curve C_{pre} in the future based on the capacity shift ΔQ and the reduction rate dQ .

Claim 49 (new): The battery capacity calculating apparatus according to claim 48, wherein the capacity shift ΔQ is expressed by a linear function of the discharged capacity Q_{mea} when the state of said battery is close to the last stage of discharging.

Claim 50 (new): The battery capacity calculating apparatus according to claim 47, wherein, when a state of said battery is not in the last stage of discharging, said operation processing means calculates the equilibrium voltage V_{equ} corresponding to the discharged capacity Q_{mea} based on the equilibrium voltage curve C_{equ} , and estimates the discharge curve C_{pre} in the future based on the voltage drop ΔV being the difference between the equilibrium voltage V_{equ} and the terminal voltage V_{mea} .

Claim 51 (new): The battery capacity calculating apparatus according to claim 50, wherein said operation processing means estimates the discharge curve C_{pre} by subtracting the voltage drop ΔV from the equilibrium voltage curve C_{equ} .

Claim 52 (new): The battery capacity calculating apparatus according to claim 50, wherein said operation processing means estimates the discharge curve C_{pre} using a maximum voltage drop ΔV_{max} corresponding to a maximum load by present in place of the voltage drop ΔV .

Claim 53 (new): The battery capacity calculating apparatus according to claim 47, wherein said operation processing means calculates a residual capacity and/or the residual power of said secondary battery based on the estimated discharge curve C_{pre} .

Claim 54 (new): The battery capacity calculating apparatus according to claim 47, wherein said operation processing means performs a judgment whether a state of said battery is near the last stage of discharging or not based on the

apparent equilibrium voltage V_{ocv} to switch an estimating method of the discharge curve C_{pre} according to a judgment result.

Claim 55 (new): The battery capacity calculating apparatus according to claim 54, wherein said operation processing means compares the apparent equilibrium voltage V_{ocv} with a predetermined threshold value to perform the judgment whether the state of said battery is near the last stage of discharging or not.

Claim 56 (new): The battery capacity calculating apparatus according to claim 47, wherein said operation processing means calculates the direct current resistance R_{dc} based on voltage changes according to current changes.

Claim 57 (new): The battery capacity calculating apparatus according to claim 47, wherein said operation processing means calculates the direct current resistance R_{dc} based on an average voltage and an average current value.

Claim 58 (new): The battery capacity calculating apparatus according to claim 47, wherein said operation processing means calculates the equilibrium voltage curve C_{equ} based on equilibrium voltages at least two points and a capacity between the equilibrium voltages.

Claim 59 (new): The battery capacity calculating apparatus according to claim 58, wherein said operation processing means calculates a shrinkage ratio S expressed by a quotient obtained by dividing a fully charged capacity of said secondary battery by a fully charged capacity of an initial battery which is not deteriorated based on the equilibrium voltages at the at least two points and a capacity between the equilibrium voltages.

Claim 60 (new): The battery capacity calculating apparatus according to claim 47, wherein said operation processing means compulsorily stops charging and obtains an equilibrium voltage based on a subsequent voltage change.

Claim 61 (new): The battery capacity calculating apparatus according to claim 47, further comprising transmitting means for transmitting the residual capacity and/or the residual power calculated by said operation processing means to an electronic apparatus using said secondary battery as its power supply.

Claim 62 (new): A battery capacity calculating program capable of being executed by a computer for calculating a residual capacity and/or residual power of a secondary battery, comprising:

equilibrium voltage curve calculating processing for calculating an equilibrium voltage curve C_{equ} showing a relation between a discharged capacity and an equilibrium voltage of said secondary battery;

voltage current measuring processing for measuring a terminal voltage V_{mea} and a current value I of said secondary battery at a time of discharging;

discharged capacity calculating processing for calculating a discharged capacity Q_{mea} of said secondary battery based on the terminal voltage V_{mea} and the current value I , both measured by said voltage current measuring processing;

apparent equilibrium voltage calculating processing for calculating an apparent equilibrium voltage V_{ocd} by adding a voltage drop ΔV_{dc} by a direct current resistance R_{dc} to the terminal voltage V_{mea} ;

apparent discharged capacity calculating processing for calculating an apparent discharged capacity Q_{ocv} corresponding to the apparent equilibrium voltage V_{ocv} calculated by said equilibrium voltage calculating processing based on said equilibrium voltage curve C_{equ} calculated by said equilibrium voltage curve calculating processing;

capacity shift calculating processing for calculating a capacity shift ΔQ being a difference between the discharged capacity Q_{mea} and the apparent discharged capacity Q_{ocv} ; and

estimating processing for estimating a discharge curve C_{pre} in a future based on the capacity shift ΔQ calculated by said capacity shift calculating processing.